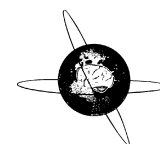


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Research paper

Home Video Telemetry vs inpatient telemetry: A comparative study looking at video quality



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ABSTRACT

Objective: To compare the quality of home video recording with inpatient telemetry (IPT) to evaluate our current Home Video Telemetry (HVT) practice.**Method:** To assess our HVT practice, a retrospective comparison of the video quality against IPT was conducted with the latter as the gold standard. A pilot study had been conducted in 2008 on 5 patients.Patients ($n = 28$) were included in each group over a period of one year.

The data was collected from referral spreadsheets, King's EPR and telemetry archive.

Scoring of the events captured was by consensus using two scorers.

The variables compared included: visibility of the body part of interest, visibility of eyes, time of event, illumination, contrast, sound quality and picture clarity when amplified to 200%.

Statistical evaluation was carried out using Shapiro–Wilk and Chi-square tests. The P -value of ≤ 0.05 was considered statistically significant.**Results:** Significant differences were demonstrated in lighting and contrast between the two groups (HVT performed better in both).

Amplified picture quality was slightly better in the HVT group.

Conclusion: Video quality of HVT is comparable to IPT, even surpassing IPT in certain aspects such as the level of illumination and contrast. Results were reconfirmed in a larger sample of patients with more variables.**Significance:** Despite the user and environmental variability in HVT, it looks promising and can be seriously considered as a preferable alternative for patients who may require investigation at locations remote from an EEG laboratory.© 2016 International Federation of Clinical Neurophysiology. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Home Video Telemetry (HVT) was introduced in the UK by King's College Hospital, London to cater for people with severe disability, learning difficulty or challenging behaviour. These patients were unsuitable for prolonged hospital admissions and required special care. However, its use could be limited to diagnostic or classification purposes and not for pre-surgical assessment where drug reduction might be involved (Beun et al., 1994).

The unique feature of HVT conducted by King's College Hospital, London are: technician supervised video and audio telemetry at patients' homes using the same recording system as inpatient telemetry (portable Nicolet system) with compatible cameras (Brunnhuber et al., 2014).

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2. Methodology

There are no national or international guidelines available for this study. Therefore, IPT was chosen as the set standard for video quality assessment due to its fixed camera and bed positions, standard hospital bed linen, environment and standard lighting conditions.

This was a retrospective study covering a time period from October 2011 to October 2012. All patients gave informed consent to the diagnostic procedures and to the reporting of the results, including the display of their videos for research purposes.

During HVT, the electrodes are placed by technicians at the patient's home or hospital and the camera is set up by the technician.

The clinical history is taken by the clinicians either at home, over the phone or via live video chat. The technicians attend the HVT site daily to review and prune the recording; similar to IPT.

Daily review and pruning of the event(s) captured are carried out by the technician in the presence of the patient and carer(s).

The patients chosen constituted a convenience sample which was non-random, ranging from 1 to 60 years old. The patients who were referred for telemetry over a one year period were included in the study with 28 patients in each group ($n = 28$). The purpose of referral had been either diagnostic or pre-surgical evaluation for the IPT.

The purpose of referral for HVT patients was diagnostic only and largely included a population with severe disabilities or learning difficulties.

Patients who did not have any events or had events off camera were excluded from the study. Patients who had been referred for sleep studies and functional stimulation were also excluded.

The following variables were chosen for the purpose of comparison of the video quality in the two groups: visibility of body part of interest; visibility of eyes; time of events captured; level of illumination; contrast (discerning the subject from the environment); sound quality and clarity of picture when amplified to 200%.

EEG recordings were carried out using the portable Nicolet system in both groups with compatible cameras.

In contrast to the fixed equipment set up in IPT, the equipment was set up by the technician in the individual patient homes during HVT.

Four different models of cameras were used during that one year period from which the patient sample was chosen. The cameras used for IPT video recording were: Panasonic WV954 and Sony HandyCam, and for HVT: Panasonic and Xvision-High resolution compact.

However, they were all of moderate-high resolution, composite and low light capable and one of the IP cameras was infrared with an infrared illuminator.

2.1. Scoring the quality

We used a consensual scoring system by two scorers (the authors: BS and LR) who reviewed the data together. Scoring of only the events captured was carried out; a cluster of events was considered as a single event. The same computer was used by us to review all events at the same amplification (200%) and lighting conditions.

All the videos pruned and saved by the technician for every patient were reviewed.

Quantification of data obtained were carried out as follows:

Visibility of body part and eyes were quantified as: yes = 1 and no = 2.

Time of the event: daytime = 1 and night time = 2.

Contrast/sound quality/quality of picture when amplified were scored ranging from 1 to 4; 1 being poor and 4 being very good.

2.2. Lighting

On = sufficient natural light and/or lights on.

Off = insufficient natural light and lights off.

2.3. Data analysis

We used Microsoft Excel Software and SPSS software for data collection and analysis.

Normality test (Shapiro–Wilk test) was chosen to assess if the data was normally distributed (H_0 = data is normally distributed; H_1 = data does not follow a normal distribution).

We found that there were statistical evidences to reject H_0 and therefore conclude that the data did not follow a normal distribution. Hence a non-parametric test, Chi-square test (H_0 = variable is independent of the type of telemetry; H_1 = variable is associated with the type of telemetry) was chosen for further analysis.

3. Results

There were no statistically significant differences in the majority of variables compared: the visibility of body part of interest (p value: 0.34), visibility of eyes (p value: 0.56), time of the event (p value: 0.40), sound quality (Table 1).

The picture quality, when amplified, showed a minor distribution difference on the “very good” category (Fig. 1), being slightly better on the HVT group (p value: 0.068). Though not statistically significant with the current number of patients, there seems to be a trend, which might have been significant if the sample size was larger.

There were statistically significant differences in lighting and contrast distributions between the two groups (Table 2). This was attributable to lights being switched off more often in IPT during the night than on HVT (Fig. 2). This had a major impact on video recording as the majority of the events occurred at night.

The background contrast shows a better quality on HVT compared to IPT ($p = 0.020$) even when the “acceptable” range was compared between the two groups. A larger number of events with poor contrast (difficult to discern subject from the surroundings) were seen in the IPT group and significant number of events with a very good contrast were seen in HVT (Fig. 1).

4. Discussion

This study was carried out to evaluate our current HVT practice.

We wanted to prove that our current HVT practice maintains similar standard as IPT irrespective of variability of the home environment.

The results of the study have proved that the variability of the home environment did not affect the quality of video recording. Despite the standardized hospital environment, HVT has surpassed IPT in certain aspects like lighting and contrast.

These results were reconfirmed in a larger sample of patients with more variables, following up from the Test re-test design that was carried out in 2008 in our department.

Table 1

Quality of variables not associated with the type of telemetry (Chi-square test: p -value $\leq 0.05 \rightarrow$ Reject H_0).

	HVT (%)	Inpatient (%)	p value
Body parts	84	88	0.34
Eyes visible	67	71	0.56
Time of event	57	52	0.40
Sound quality	100	100	–

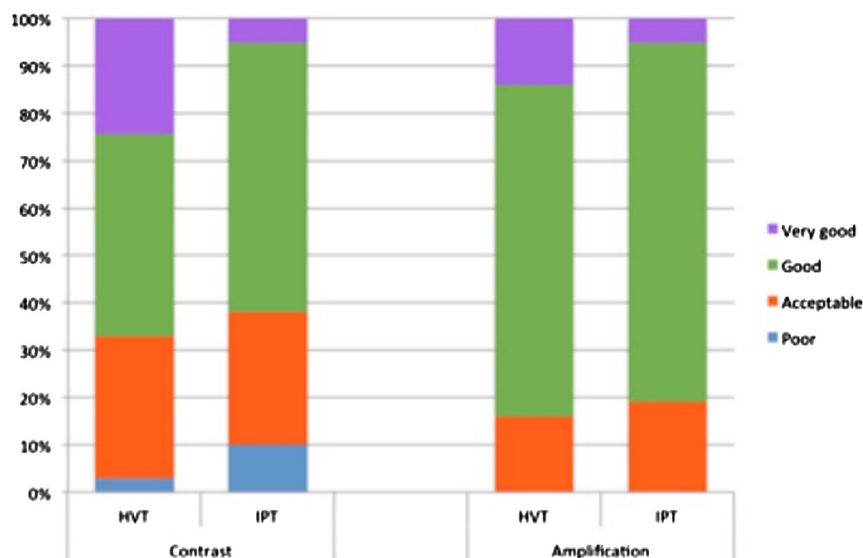


Fig. 1. Quality of variables in favour of Home VT.

Table 2
Statistical difference found in favour of HVT video quality.

	HVT (%)	Inpatient VT (%)	p value
Lights on at night (subject well illuminated)	96	76	<0.001
Contrast (at least acceptable)	97	90	<0.020

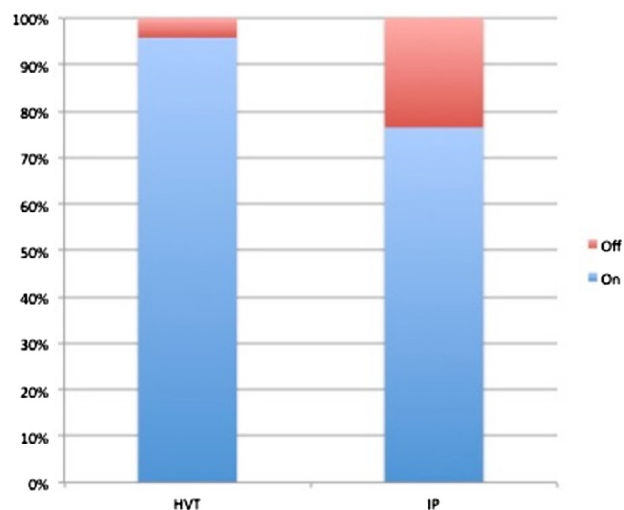


Fig. 2. Quality of illumination in favour of Home VT as a result of lights being switched off more often during the inpatient telemetry.

Although this is a study based on a small number of patients ($n = 28$), it should be borne in mind that HVT was still in its embryonic phase and finding an adequate number of patients in this group was difficult, especially after we had excluded those patients where no events were captured.

This study was based purely on video quality by analysing the events captured. Therefore, no confounding factors were identified relating to age, co-morbidities, disabilities and the purpose of telemetry referrals.

The HVT service provided by King's College Hospital, supervised by the technicians, where the equipment installation and daily

reviews are carried out by them, has a major impact on the video quality (Video 1).

It is seen that light plays a major role in the quality of video recording. Therefore, educating nursing staff in the hospital is crucial for maintenance of good video quality.

Standardization of infra-red cameras especially aiming to record all night time events, might have an effect on the results. However, the basic principle of photography, where the subject of interest has to be well illuminated, is dependent on light and contrast and is still applicable irrespective of the type of camera used (Video 2).

Home Video Telemetry looks promising and seems to be a preferable alternative for those patients who may require investigation at locations remote from an EEG laboratory.

5. Conclusion

The quality of video recording in HVT is comparable to IPT and equipment alone cannot produce a high quality video recording. The ability to use the equipment appropriately has a significant effect.

Conflicts of interest statement

The authors report no conflict of interest.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.cnp.2016.05.001>.

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